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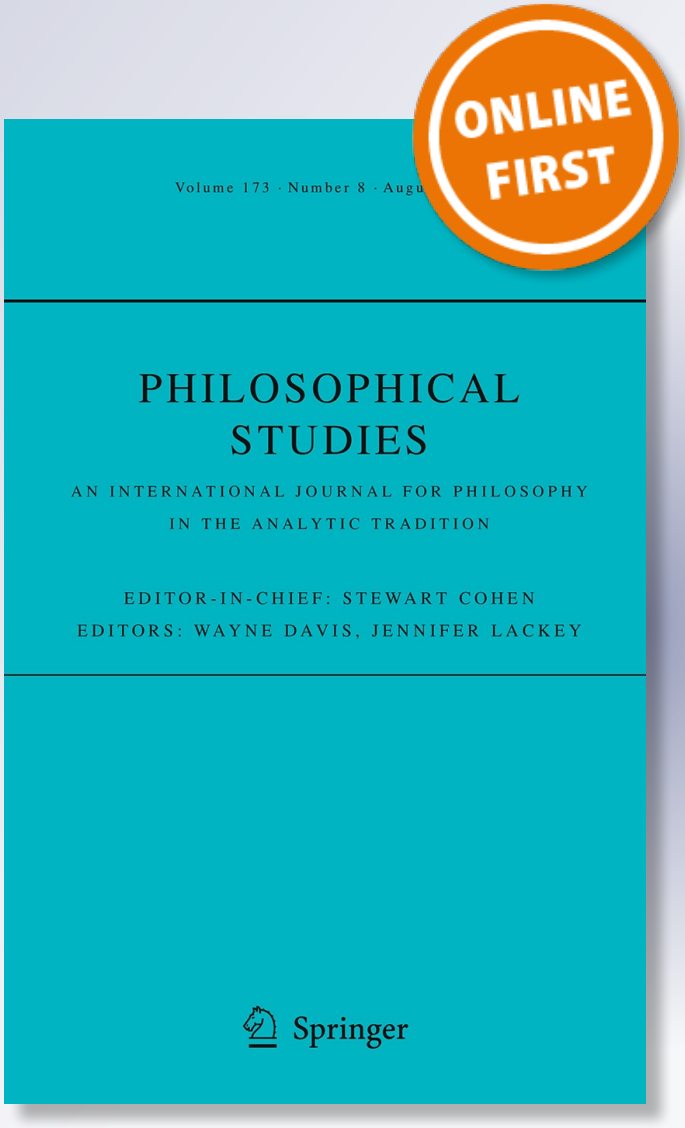

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David H. Glass[1]

Abstract In discussions about the existence of God, it is sometimes claimed that the progress of science has removed the need for God. This paper uses a Bayesian analysis of Ockham's razor to formulate and evaluate this argument, which is referred to as the *science explains away God argument* (SEAGA). Four different strategies for responding to this argument are presented and evaluated. It is argued that one of these strategies highlights how difficult it is to show that the conditions for applying Ockham's razor are satisfied and hence why SEAGA is very unlikely to succeed.

Keywords Explaining away · Ockham's razor · Bayesian reasoning · Atheism

1 Introduction

Science plays a key role in many discussions about the existence of God. Theists often appeal to various aspects of science in support of their belief in God while atheists sometimes respond, not merely by contesting this point, but by arguing precisely the opposite: that science undermines belief in God. Both sides might appeal to specific aspects to bolster their position: theists typically focussing on the big bang or fine-tuning; atheists typically pointing to evolution. Alternatively, they might appeal to more general issues relating to science: theists claiming that the laws of nature or the very possibility of science points to a Creator; atheists countering that scientific methodology itself and the success of science do just the opposite. The focus of this paper is on this last point: that the success of science in

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explaining the world around us counts against theism. Few would wish to claim that science is logically incompatible with the existence of God, but some claim that it undermines the case for God by making theistic explanations redundant. The idea is that while it might have made sense to believe in God as an explanation for various features of the natural world before the advent of modern science, this is no longer the case since theistic explanations have been replaced by scientific explanations. While the two accounts are not necessarily incompatible, Ockham's razor suggests that there is no need for two accounts when one will do. Essentially, this means that science has explained away, or at least is in the process of explaining away, the need for God and so the argument will be referred to as the *science explains away God argument* (SEAGA). This view is expressed by Sean Carroll in a recent article:

> Over the past five hundred years, the progress of science has worked to strip away God's roles in the world. He isn't needed to keep things moving, or to develop the complexity of living creatures, or to account for the existence of the universe… Two thousand years ago, it was perfectly reasonable to invoke God as an explanation for natural phenomena; now, we can do much better. (Carroll 2012, p. 196)

This argument is very prominent among the so-called New Atheists such as Richard Dawkins (2006) and Victor Stenger (2008). An argument along these lines is often used in the specific case of evolution, see for example Dennett (1996) and Draper (2008).[1] Other arguments that appeal to the success of science in general, even if not quite conforming to SEAGA, can also be found in the literature (see for example Draper (2005) and Dawes (2009)), although the specific details of these argument will not be explored here.[2]

An earlier statement of SEAGA is found in the *Summa Theologica* of Thomas Aquinas when he addresses two objections to the existence of God. One of these is a version of the problem of evil, while the second is as follows:

> Further, it is superfluous to suppose that what can be accounted for by a few principles has been produced by many. But it seems that everything we see in the world can be accounted for by other principles, supposing God did not exist. For all natural things can be reduced to one principle which is nature; and all voluntary things can be reduced to one principle which is human reason, or will. Therefore there is no need to suppose God's existence. (Aquinas 1947, I, q.2, a.3)

In a detailed discussion of the argument, Peter van Inwagen draws attention to the fact that its conclusion is not the proposition that God does not exist, but rather that there is no need to suppose God's existence or, as he puts it, that God is an unnecessary hypothesis (van Inwagen 2005). Van Inwagen raises serious objections to various ways in which the argument might be used to reach either an atheistic or agnostic conclusion. His most fundamental reason, however, for rejecting the claim

[1] For a response in this case, see Plantinga (2011).

[2] Responses to these particular arguments will be presented in a future paper.

that God is an unnecessary hypothesis is that God is not an hypothesis at all. While van Inwagen thinks there are good arguments for God's existence, he does not base his belief in God on these arguments. In contrast to his approach, here the existence of God will be considered from an evidentialist perspective as an hypothesis that can in principle be confirmed or disconfirmed by explanatory considerations.[3] Also, rather than evaluating whether the argument can be used to establish atheism or agnosticism as the most reasonable position, the focus will be on whether the success of science undermines or counts against God's existence.

This paper will explore SEAGA by drawing on a probabilistic formulation of 'explaining away' and showing how it relates to the application of Ockham's razor. The concept of explaining away has been studied in the artificial intelligence literature through the use of probabilistic models (Wellman and Henrion 1993) and a similar formulation has been adopted in earlier work on design arguments (Glass 2012; Glass and McCartney 2014). In addition to (a) providing a Bayesian analysis of SEAGA, the paper (b) presents and evaluates strategies that theists could adopt in response to SEAGA, and (c) illustrates the relevance of this approach by considering how the New Atheism draws on the success of science to argue against theism.

2 Ockham's razor and explaining away

Ockham's razor is a widely discussed principle of reasoning which appeals to simplicity and is attributed to William of Ockham. One statement of this principle is that 'Entities should not be multiplied beyond necessity' and another that 'It is futile to do with more things that which can be done with fewer'. The general idea is that when two or more hypotheses account for some body of evidence then the simpler hypothesis is to be preferred, *ceteris paribus*. Spelling out exactly what simplicity amounts to, however, is not so simple (Baker 2013).

For present purposes, an explaining away version of Ockham's razor will suffice. It can be stated as follows: *there is no need for two hypotheses when one will do*. To take a simple example, suppose your car will not start. One possible hypothesis is that the battery is flat; another that there is a fault with the starter motor. Suppose also that further investigation reveals that the battery is indeed flat. Given this information, there is no longer an reason to think that there is a problem with the starter motor. Of course, you could be very unlucky; there could be a problem with the starter motor too. However, based on the evidence of the car not starting and the fact that the battery is flat, any reason for inferring a problem with the starter motor has gone. There is no need to infer two hypotheses (flat battery and faulty starter motor) when one will do (flat battery). It is clear that Ockham's razor applies in this

[3] This is not to say that the rationality of belief in God *requires* thinking of God as an explanatory hypothesis, nor that God is merely an hypothesis, but just that in the context of evaluating arguments for and against the existence of God it makes sense to ask whether an explaining away argument might have force.

case. Or, in the terminology of explaining away, the flat battery hypothesis has explained away the faulty starter motor hypothesis.[4]

Consider, however, another case. Suppose a friend is going to get the train to meet you after work. You go to meet him at the railway station as planned, but he is not there. One hypothesis is that he missed the train and another is that he was delayed at work. In this case, accepting the latter hypothesis does not remove the need for the former since they could easily both be true; he could have missed the train *because* he was delayed at work. Indeed, accepting one of these hypotheses seems to make the other more likely to be true. It is clear that in this case Ockham's razor does not apply.[5]

The fairly obvious but important point is that Ockham's razor cannot be applied automatically to remove the need for one hypothesis based on the acceptance of another. Under what conditions can Ockham's razor be applied? The following discussion summarizes earlier work on explaining away to address this question.

Suppose that in some context there are two explanatory hypotheses to account for a given body of evidence E. These hypotheses will be referred to as the initial hypothesis, H_I, and the alternative hypothesis, H_A. Let us also assume that the two hypotheses are such that they are confirmed by E, which will be understood in terms of Bayesian confirmation theory so that $P(H_I|E) > P(H_I)$ and $P(H_A|E) > P(H_A)$. We will relax this assumption later. In such a context, the idea is that given evidence E, if the alternative hypothesis H_A is discovered to be true it explains away the initial hypothesis H_I if it disconfirms it, i.e. if $P(H_I|E, H_A) < P(H_I|E)$. Different cases can be distinguished as follows (Glass and McCartney 2014):

- No Explaining Away: $P(H_I|E, H_A) \geq P(H_I|E)$.
- Partial Explaining Away: $P(H_I) < P(H_I|E, H_A) < P(H_I|E)$.
- Complete Explaining Away: $0 < P(H_I|E, H_A) \leq P(H_I)$.
- Absolute Explaining Away: $P(H_I|E, H_A) = 0$.

In the case of partial explaining away, the effect of discovering H_A to be true is to reduce the probability of H_I somewhat, but not down to its original level before E was taken into account. This means that there is still some residual confirmation of H_I. In the case of complete explaining away, the initial confirmation of H_I by E has been completely negated by H_A, while absolute explaining away would establish the falsity of H_I, which would be the case if H_I and H_A were incompatible.

[4] Slightly different locutions can be used for explaining away. Strictly speaking it involves two hypotheses and evidence, so we might say that one hypothesis explains away the evidence for the other hypothesis, but a shortened version of this is just to say, as here, that one hypothesis explains away another hypothesis, where the role of the evidence is assumed.

[5] It might be objected that your friend's missing the train removes his being delayed at work as an explanation for not being at the station. Being delayed at work is still needed as an explanation for why he missed the train, but not for the original explanandum. While the transitivity of explanation can be questioned, it certainly holds in some cases otherwise it is not all clear that being delayed at work would explain his missing the train since some other intermediate event, such as arriving at the station late, could be introduced as an alternative to being delayed at work. In this case, there does not seem to be any good reason to deny transitivity.

Suppose that H_I and H_A are independent before evidence E is taken into account, $P(H_I|H_A) = P(H_I)$. In such a case, learning that H_A is true has no effect on the probability of H_I. However, this is no longer the case when conditioning on the evidence E that the hypotheses explain. The condition for explaining away, i.e. at least partial explaining away, to occur is then given by (Wellman and Henrion 1993, Eq. (4); Glass 2012, Eq. (7)):

$$P(E|H_I, H_A) \cdot P(E|\neg H_I, \neg H_A) < P(E|\neg H_I, H_A) \cdot P(E|H_I, \neg H_A). \tag{1}$$

Alternatively, if there is a dependence between H_I and H_A, then the corresponding condition is (Glass 2012, Eq. (6)):[6]

$$\begin{aligned} &P(E|H_I, H_A) \cdot P(E|\neg H_I, \neg H_A) \cdot P(H_A|H_I) \cdot P(\neg H_A|\neg H_I) \\ &< P(E|\neg H_I, H_A) \cdot P(E|H_I, \neg H_A) \cdot P(H_A|\neg H_I) \cdot P(\neg H_A|H_I). \end{aligned} \tag{2}$$

If only partial explaining away occurs, there will still be what we will call residual confirmation of H_I after H_A is taken into account since $P(H_I|H_A, E) > P(H_I)$. The degree of residual confirmation is taken to be the degree of confirmation of H_I by the conjunction of E and H_A. Various measures of confirmation could be used, but it is important here that if partial explaining away occurs then the degree of residual confirmation should be less than the degree of confirmation of H_I by E alone. One measure that satisfies this criterion and also has a number of advantages over other measures is the log-likelihood ratio measure (Glass and McCartney 2015). Using it the degree of residual confirmation is given by:

$$\log \left[\frac{P(E, H_A|H_I)}{P(E, H_A|\neg H_I)} \right]. \tag{3}$$

Previous work considered explaining away not only in the case where the alternative hypothesis is discovered to be true, but also in the case where there is some independent, non-conclusive evidence for it (Glass 2012). This involves a relatively straightforward extension of the above expressions, however, since the weaker the evidence for the alternative hypothesis, the weaker is the case that explaining away occurs *ceteris paribus*. For this reason, the details will not be presented here.

[6] *Proof* The condition for (at least partial) explaining away to occur is $P(H_I|E, H_A) < P(H_I|E)$ or equivalently $P(H_A|E, H_I) < P(H_A|E)$, which in turn can be expressed as $P(H_A|E, H_I) < P(H_A|E, \neg H_I)$. Given Bayes' theorem and assuming the relevant probabilities are defined and non-zero, this can be expressed as:

$$\frac{P(E|H_I, H_A) \cdot P(H_A|H_I)}{P(E|H_I)} < \frac{P(E|\neg H_I, H_A) \cdot P(H_A|\neg H_I)}{P(E|\neg H_I)}.$$

Expressing $P(E|H_I)$ and $P(E|\neg H_I)$ in terms of appropriate weighted sums of probabilities of E given H_I and H_A and their negations gives:

$$\begin{aligned} &P(E|H_I, H_A) \cdot P(H_A|H_I) \cdot [P(E|\neg H_I, H_A) \cdot P(H_A|\neg H_I) + P(E|\neg H_I, \neg H_A) \cdot P(\neg H_A|\neg H_I)] \\ &< P(E|\neg H_I, H_A) \cdot P(H_A|\neg H_I) \cdot [P(E|H_I, H_A) \cdot P(H_A|H_I) + P(E|H_I, \neg H_A) \cdot P(\neg H_A|H_I)], \end{aligned}$$

from which (2) follows. In the case where H_I and H_A are independent, (1) can be derived from (2) since $P(H_A|H_I) = P(H_A|\neg H_I)$ and $P(\neg H_A|H_I) = P(\neg H_A|\neg H_I)$.

The idea here is to use the above account of explaining away to capture how Ockham's razor works in the context of science and theism. One feature is that it generalizes the notion of Ockham's razor so that it need not be an all or nothing affair as it was in the examples discussed earlier, completely removing the support for the faulty starter motor hypothesis (complete explaining away) and not removing the support at all for the hypothesis that your friend was delayed at work (no explaining away). One hypothesis might weaken the support for the other (partial explaining away) without removing its support completely. Ockham's razor would be said to apply, at least to some extent, if at least partial explaining away occurs.

A limitation of using this account of explaining away in the context of Ockham's razor is that it presupposes that both hypotheses are confirmed by the evidence in the first place. While this might be true in many cases, it is far from clear that this is required for Ockham's razor to be applied. In particular, in the context of science and theism, proponents of the use of Ockham's razor to weaken the support for theism might deny that relevant evidence confirms theism at all. This might be because they deny that theism has any explanatory merit, in which case it is not really science that is doing the work via Ockham's razor, but rather a philosophical view about the explanatory merits or otherwise of theism. Still, if science undermines theism by making it less plausible than it would be otherwise a very similar type of reasoning is at work. Alternatively, some might grant that theism has explanatory merit, at least in principle, but deny that this should be equated with confirmation by the evidence it explains.

The limitation noted above can be resolved simply by removing the restriction that the hypotheses need to be confirmed by the evidence in the first place. In the case of two hypotheses, H_I and H_A, that have been proposed for E, Ockham's razor would be said to apply, at least to some extent, if accepting one hypothesis disconfirms the other hypothesis given E, $P(H_I|H_A, E) < P(H_I|E)$. Note that this is the same condition as that for at least partial explaining away to occur, but it does not presuppose confirmation of the hypotheses by the evidence in the first place.

Now we are in position to identify the conditions under which Ockham's razor, or at least the explanatory version of it we have in mind here, occurs because it turns out that Ockham's razor will apply to at least some extent if expression (2) is satisfied, or expression (1) in the case where the hypotheses are independent given background knowledge alone. This account will now be used in the context of science and theism.

3 Science versus theism?

The idea is to evaluate the claim that science removes or weakens the need for theism via Ockham's razor by using the probabilistic formulation outlined above. In order to do this, let us replace H_I in the formalism introduced in Sect. 2 by theism, T, H_A by science, S, and let E represent the evidence in the natural world for which both theism and science could be considered to provide explanations.[7] Clearly, there

[7] Note that this places a constraint on what kinds of evidence could be considered under E. For example, if Swinburne (2004) is right that fundamental scientific laws have a theistic, but not a scientific, explanation then Ockham's razor could not be applied to such laws.

are limitations to this representation. For example, it is far from clear what it means to say that science explains some body of evidence E. Rather, it is *particular* scientific theories that explain a given body of evidence. Furthermore, whether a scientific theory weakens the need for a theistic account may well differ from one case to another. Still, the claim under consideration is that in many (if not all) cases Ockham's razor does apply to a greater or lesser extent, so modelling the argument in this generic way enables us to identify the underlying idea as well as broad strategies theists might adopt in response to it.

The argument that the success of science in explaining natural phenomena removes or weakens the need for theism via Ockham's razor can be summarized in the following argument:

SEAGA (Science Explains Away God Argument)

(1) Science S explains various features of the natural world E for which theism T might also be thought to provide explanations.
(2) There are good reasons to accept these scientific explanations as an account of reality.
(3) In the context of E, Ockham's razor can be applied to science S and theism T.

Therefore, science disconfirms theism given E, i.e. $P(T|S,E) < P(T|E)$.

Given the account of Ockham's razor in Sect. 2, the conclusion will follow from the premises. Some clarification is needed on premise (1). What features of the natural world might be included under E in premise (1)? The idea is to include features of the natural world for which there are generally agreed upon scientific explanations. So, for example, the fine-tuning of physical parameters would not be included since there is no scientific explanation that has achieved a consensus, although it has been discussed in previous work in the context of explaining away (Glass 2012). Premise (1) is also intended to exclude theistic explanations that are direct rivals to accepted scientific explanations. So, for example, it would exclude theistic explanations such as the direct creation of the fossil record by God. Clearly, the application of Ockham's razor would be trivial in such cases and so the point of the paper is to explore its application in cases that do not involve this kind of incompatibility. The most obvious features of the natural world that would be included in E would be those exhibiting order that can be explained scientifically since theism might also be thought to provide an explanation. This includes order in the solar system that can be understood in terms of gravitation and a multiplicity of other cases that can be understood in terms of the theories of electromagnetism, evolutionary biology, etc.

Premise (2) presupposes scientific realism. This provides an obvious way to respond to the argument since given an anti-realist position with respect to science, the argument loses its force. We will not pursue this option here, but simply assume a realist position for the sake of the argument. As noted in the earlier discussion on explaining away in Sect. 2, the relevant conditions apply not only in cases where one of the hypotheses is known to be true, but also when there is evidence to support it. This means that the argument does not require belief that science gives us the

truth, but just that science is well-confirmed. Our focus then will be on premise (3) and on whether the conditions for applying Ockham's razor are satisfied.

How might the advocate of SEAGA defend premise (3)? Essentially it requires arguing that expression (2) in Sect. 2 is satisfied. We can think of this expression as comprising two components. The first is in terms of the direct relationship between science and theism and so terms such as $P(S|T)$ and $P(S|\neg T)$ which do not take E into account. We will consider this relationship under strategy 4 below, but in general this relationship is not what defenders of SEAGA focus on. Appealing to Ockham's razor does not involve a direct disconfirmation of theism, but rather an indirect disconfirmation by virtue of how science explains E. This brings us to the second component in expression (2) and this concerns the probability of E given various combinations of science and theism and their negations, i.e. terms such as $P(E|T, S)$.

For simplicity, let us assume that science and theism are independent given only background knowledge, i.e. $P(S|T) = P(S|\neg T)$. In that case it needs to be shown that expression (1) in Sect. 2 is satisfied. Here the defender of the argument only needs to show that $P(E|T, S) \times P(E|\neg T, \neg S)$ is less than $P(E|T, \neg S) \times P(E|\neg T, S)$ and *prima facie* this seems plausible. Assuming that adding theism to science adds little or nothing to the likelihood of E so that $P(E|T, S)$ is at most not much greater than $P(E|\neg T, S)$, it can be argued that the probability of E would be very low in the absence of both science and theism and so that $P(E|\neg T, \neg S)$ would be much lower than $P(E|T, \neg S)$. That being the case, it seems reasonable to conclude that expression (1) would be satisfied and hence the condition for applying Ockham's razor would be met. The reasoning here is similar to that involved in the car example discussed earlier. Similar arguments might be used to show that expression (2) is also satisfied in cases where science and theism are not assumed to be independent given background knowledge, although as will be argued later, the possibility of a positive dependence raises problem for SEAGA.

The general approach adopted in SEAGA is straightforward, so we will now consider four strategies that theists might adopt in response to SEAGA and evaluate each in turn.

3.1 Strategy 1: independence

According to this strategy, E is independent of theism, and so provides no evidence for it in the first place, and science has no effect on theism either. In probabilistic terms $P(T|E, S) = P(T|E) = P(T)$ and so the conditions for applying Ockham's razor would not be met. Theists adopting this position will claim that it is a mistake to think of theism in terms of providing explanations for features of the natural world that are amenable to scientific explanation and that science itself has no bearing on the existence of God. Since E is only taken to include features of the universe that are explained by generally accepted science, the proponent of this strategy might still appeal to some features of the universe that are not explained by science as evidence for God. Alternatively, theists might reject all the arguments of natural theology, adopting some kind of fideism or perhaps argue that belief in God is properly basic, or they might appeal to the moral argument, for example.

A possible challenge for this position concerns whether the theist can consistently claim that theism is independent from the features of the universe captured in E and from science itself. Given the condition $P(T|E) = P(T)$, or equivalently $P(E|T) = P(E)$, this seems to imply that God's existence makes no probabilistic difference to E since it is no more probable given God's existence than it would be otherwise. If God is considered to be the creator of the universe, can this kind of independence be maintained? Or to put it another way, can God make a difference without making a probabilistic difference? At least for the kind of epistemic probability relevant here, the answer seems to be 'yes' since one could believe, perhaps on the basis of revelation, that God brought about some feature of the universe, E_1 say, without believing that E_1 increases the probability of God's existence. However, while this may well be true for some features of the universe included in E, it is not clear that all such features of the universe must be independent of theism. Arguably, it is more plausible to think that E is independent of theism *given scientific explanations* (S) for E, as will be discussed in the context of strategy 4, but the current strategy requires not only that E is unconditionally independent of theism, but also that science itself is independent of theism.

The independence strategy would certainly avoid Ockham's razor and for theists that might seem like a major point in its favour, but if it is to be adopted in response to SEAGA it would need to be motivated on other grounds. While this should not be ruled out, it seems reasonable to believe that independence might fail to hold in at least some cases and hence that theism might be confirmed or disconfirmed by some features in E or by science itself. For this reason, and given the evidentialist viewpoint adopted in this paper, other strategies will now be considered.[8]

3.2 Strategy 2: joint explanations

Consider again expression (1) where the two hypotheses are considered to be independent given only background knowledge. By investigating this case in the context of science and theism, it enables us to isolate the effect of this strategy in order to evaluate it. A typical scenario where Ockham's razor can be avoided is where two hypotheses are needed to account for the evidence. For example, an industrial accident could be explained in terms of both human error and the failure of a safety mechanism. Suppose that in the absence of either factor the accident would have been extremely unlikely and that it would have only been marginally more likely given one of the factors on its own, but very likely indeed given both factors. In such a scenario, Ockham's razor would not apply and so learning that one hypothesis is true, human error say, would not undermine the other hypothesis. In terms of science and theism, the theist might attempt to argue that the probability of

[8] Peter van Inwagen's approach, noted in the introduction, could be considered as a variant of this strategy. While he thinks the existence of the natural world is explained by God (and so he does not make any claim of independence), he does not think that belief in God needs to be based on inferring God as the best explanatory hypothesis. However, since no independence claim is made, this leaves open the possibility that scientific explanations could undermine belief in God to some extent. Hence, at least from an evidentialist perspective, it is worth considering other strategies.

E given science without theism, $P(E|\neg T, S)$, would be low, perhaps not much greater than $P(E|\neg T, \neg S)$. By contrast, the probability of E given both science and theism, $P(E|T, S)$, would be greater and it would also need to be greater than that for theism without science, $P(E|T, \neg S)$.

To make this kind of argument, the theist might claim that certain features of the world would be more likely given science in a theistic universe than an atheistic universe. If God had reason to bring these features about, that would provide a reason for God to create the universe with appropriate initial conditions or to guide the process in some way. Such claims are often made by theists in the context of the evolution of life.

Whether such claims can be defended, there are at least three problems with using them as a response to the SEAGA argument. First, even if it is granted that $P(E|\neg T, S)$ is lower than $P(E|T, S)$ in a given case, if $P(E|\neg T, \neg S)$ is plausibly much lower still, the condition for applying Ockham's razor may still be met. Secondly, recall that the theist needs to argue that $P(E|T, S)$ is greater than $P(E|T, \neg S)$ and given the first point it might need to be significantly greater. Yet, if God has reason to bring E about and so it is theism that makes the difference, it is not clear what the justification for $P(E|T, S)$ being greater than $P(E|T, \neg S)$ would be. Finally, even if some of these claims can be justified in certain cases, it is not at all clear that it would be a plausible strategy for responding to SEAGA in general since it places so much emphasis on science needing theism to account for the relevant evidence.

3.3 Strategy 3: bite the bullet

The theist could accept the SEAGA argument, acknowledging that science disconfirms theism given evidence E. Two distinct positions that fall into this category can be distinguished. According to one position, not only is SEAGA sound, but the conjunction of science and E also fails to confirm theism. This could be because science succeeds in negating any initial confirmation of theism by E or because E did not confirm theism in the first case and science only makes the situation worse. The theist could, of course, claim that there are other reasons for belief in God, some of which could be based on features of the universe not contained in E such as design arguments based on fine-tuning of physical parameters. Overall, the theist might argue that the reasons in favour of God's existence outweigh the disconfirmation due to SEAGA.

This sort of response is open in any context where a claim of disconfirmation, such as that found in SEAGA, has been made, but it seems rather weak in this case. First, in accepting SEAGA, the theist grants the force of a significant and potentially powerful argument against theism based on the success of science. Second, insofar as the theist's favoured arguments appeal to features of the universe that might be amenable to scientific explanation in the future, this raises the question of whether they will succumb to SEAGA in due course. Neither of these concerns is fatal to this strategy and if there are good reasons to accept SEAGA, it seems like a sensible approach for the theist to adopt. Furthermore, as with the previous response, perhaps

the theist could adopt this strategy in certain specific cases, but it seems reasonable for the theist to seek a better response to SEAGA in general.

There is another way, however, in which the theist could accept SEAGA without it being so detrimental to theism. The theist could attempt to argue that although SEAGA is sound there is still considerable residual confirmation of theism. That is, that the sort of evidence E under consideration provides initial confirmation of theism that is not completely undermined by the success of science. In other words, the theist could accept that partial explaining away occurs, but not complete explaining away. In effect, this amounts to saying that the conjunction of science and evidence E confirms theism. If this is correct, the theist could claim that the apparent force of SEAGA is misleading and only arises because of an artificial separation of science from evidence E. Science S disconfirms theism when the evidence E, which science explains, is taken as background information, but it is easy to forget that, prior to S, E confirms theism, and this prior confirmation needs to be factored into the discussion.

How might the theist go about arguing for such a position? Note that residual confirmation as defined in (3) can be expressed as follows in the case of science and theism:

$$\log\left[\frac{P(E,S|T)}{P(E,S|\neg T)}\right] = \log\left[\frac{P(E|T,S)}{P(E|\neg T,S)}\right] + \log\left[\frac{P(S|T)}{P(S|\neg T)}\right]. \tag{4}$$

As discussed in the context of the second strategy, the theist might attempt to argue that $P(E|T,S) > P(E|\neg T,S)$, and hence that the first term on the right hand side is positive, but it is not clear that this would be a good strategy in general. However, it does seem plausible to think that the first term is non-negative, i.e. that $P(E|T, S)$ is no lower than $P(E|\neg T,S)$. Hence, if the theist can plausibly argue that the second term on the right hand side is positive, i.e. that science itself confirms theism, then the condition for confirmation of theism by the conjunction of science and E would be met. Arguably the theist can make a plausible case here and so this strategy is open to the theist, but since this approach need not be constrained to the current strategy, which accepts SEAGA, we will discuss this point further under the next strategy.

3.4 Strategy 4: science depends on theism

As noted earlier, we can think of the condition for applying Ockham's razor in expression (2) as comprising two components: one in terms of the direct relationship between science and theism and involving terms such as $P(S|T)$ which do not refer to the evidence, and the other in terms of the indirect relationship between science and theism via the evidence and so involving terms such as $P(E|T,S)$. It was pointed out that SEAGA focusses on the indirect relationship since the claim is generally not that science directly disconfirms theism, but that it does so by making theism redundant—theism is no longer needed to account for the evidence.

However, since the direct relationship between science and theism is relevant to the conditions for applying Ockham's razor, an obvious strategy for the theist is to

argue for a positive direct relationship between science and theism by arguing that science depends on theism. Here we consider three ways in which the theist might argue for this. First, the theist could argue that some scientific explanations of features of the universe included in E (i.e. for which there are accepted scientific explanations) depend on other features of the universe not included in E which in turn depend on theism. For example, evolution requires a fine-tuned universe, which in turn provides the starting point for a design argument.

Secondly, the theist could argue that some scientific explanations of features of the universe included in E depend on other scientific theories which themselves confirm theism. In particular, our modern understanding of the evolution of the universe depends on big bang cosmology, which in turn provides the starting point for a version of the cosmological argument.[9]

Thirdly, the theist could argue that the very existence of scientific laws confirms theism since such laws describe order in the universe which, the theist could argue, is more to be expected given theism than given non-theism. This view is certainly consistent with that of many of the founders of modern science, such as Kepler, whose theistic beliefs motivated their search for scientific laws. This type of argument is found in modern defences of the design argument (see Swinburne (2004)) with the qualification that it is the fundamental laws of science that point to design because while they can be used to explain other laws, they cannot themselves be explained scientifically.

Are these arguments successful? Obviously there is disagreement about this, but suffice it to say that all three are serious arguments for theism and that defences as well as critiques can be found in the literature. Since these arguments would provide strong reasons for thinking that there is a positive direct dependence between science and theism, i.e. $P(S|T) > P(S|\neg T)$, they would call into question the suggestion that the condition for Ockham's razor is met and hence raise a serious question mark over the controversial third premise of SEAGA. Proponents of SEAGA may well reject these theistic arguments and deny any positive dependence between science and theism, but if SEAGA is to have any force for others who disagree the burden of proof is on the defender of SEAGA to refute these theistic arguments as part of a case for showing that the conditions for applying Ockham's razor are satisfied.[10]

While this strategy would raise serious questions for SEAGA, it does not completely rule it out. As discussed in the context of expression (3) under strategy 3, a positive direct dependence between science and theism would make it very plausible to think that there is at least residual confirmation of theism and hence that at most partial explaining away occurs. Could the theist make the stronger claim that such a positive dependence would completely rule out SEAGA? Interestingly the

[9] The Leibnizian cosmological argument also seems relevant since, if successful, it establishes God as the cause of the contingent physical universe.

[10] The proponent of SEAGA might claim that SEAGA can be treated separately from these theistic arguments. The claim would be that SEAGA provides a reason against theism irrespective of the force of these theistic arguments. The problem with this, however, is that the theistic arguments are directly relevant to evaluating premise (3) of SEAGA.

answer is 'yes'. If theism is conditionally independent of E given science, i.e. $P(E|T,S) = P(E|S)$, then the positive dependence between science and theism can be expressed as $P(T|E,S) > P(T|E,\neg S)$, which in turn can be expressed as $P(T|E,S) > P(T|E)$ and so the conclusion of SEAGA would be shown to be false.

Interpreting this conditional independence relationship between T, S and E in causal terms, it is closely related to the view that God acts in the world via secondary causes. That is, God does not act directly in the world, but indirectly via natural processes which are described by the laws of science.[11] This view has a long history. Writing about the attitude of early natural philosophers, historian John Henry writes,

> God was always recognized as the first (or primary) cause, without whom nothing would be as it is; but the natural philosopher was concerned to understand phenomena in terms of the secondary causes through which it was assumed that God always chose to operate. (Henry 2010, p. 42)

This idea is, of course, found in the work of Thomas Aquinas and so in response to his second objection to belief in God, which was quoted in the introduction, he writes:

> Since nature works for a determinate end under the direction of a higher agent, whatever is done by nature must needs be traced back to God, as to its first cause. (Aquinas 1947, I, q.2, a.3)

While theists need not be committed to the view of God acting via secondary causes, it provides a plausible way for thinking about the relationship between theism and science and, if correct, rules out even the possibility of SEAGA if there is a positive dependence between science and theism.[12]

In summary, strategy 4 offers the strongest response to SEAGA. By drawing on standard theistic arguments it calls into question the appeal to Ockham's razor in premise (3) of SEAGA. This means that the burden of proof is on the defender of SEAGA to refute these theistic arguments as part of a case for showing that the conditions for Ockham's razor apply, but if that is the case SEAGA seems to lose its intuitive appeal. It might have been thought that SEAGA would provide a powerful argument against theism by appealing to science and Ockham's razor without having to get bogged down in traditional theistic arguments, but that turns out not to be the case. Furthermore, if in addition to the dependence between science and theism, the conditional independence relationship identified holds, SEAGA can be ruled out completely.

[11] Recalling that E is limited to what can be explained by science, it leaves open the possibility that some of God's action in the world may not occur via secondary causes.

[12] It might be objected that according to this view explaining away has occurred in a certain sense. God is no longer appealed to as an explanation of the evidence in question since it is now explained by science. Instead, God is being appealed to in order to explain something else, science itself. Using our notation, we could say that T causes S and S in turn causes E. In terms of secondary causes, however, it would also be correct to say that T causes E via S or, in terms of explanation, that T explains E by explaining S. If this is correct, God has not been removed as an explanation of the evidence in question. Note that the theist need not be committed to the transitivity of explanation in general to make this claim.

3.5 Discussion

The foregoing account of SEAGA and strategies for responding to it highlight why it is a tempting objection to theism and yet why it is very unlikely to succeed. With regard to the former, SEAGA appeals to a common type of reasoning that applies in many contexts and might initially seem plausible in the context of science and theism as well. Furthermore, the first strategy offered in response might only confirm SEAGA's appeal since it seems to avoid the force of SEAGA by making theism less relevant to the world. The second and third strategies likewise might suggest that the theist is just trying to salvage something from a bleak situation.

On the other hand, the fourth strategy shows why SEAGA is very unlikely to succeed: it is going to be too difficult to show that the conditions for applying Ockham's razor, and hence SEAGA, are satisfied. This is because taking a view on this requires taking a view on substantive issues about the relationship between science and theism in the first place. Anyone who does not already think that there is a negative dependence between science and theism and reject the theistic arguments mentioned is unlikely to find SEAGA persuasive.

4 SEAGA and the New Atheism

It is well known that the New Atheists give considerable weight to science in their case against religious belief. Since many criticisms of the New Atheism have been provided, the goal here is not to provide a detailed response to their arguments, but (a) to highlight the fact that their appeal to science in support of atheism is best understood not as a claim of incompatibility but as an explaining away argument similar to SEAGA, and (b) to illustrate the relevance of the discussion of SEAGA in Sect. 3 to identify why this argument fails.

Pointing to the success of science, the New Atheists claim that God has become redundant. Dawkins writes, 'Historically, religion aspired to explain our own existence and the nature of the universe in which we find ourselves. In this role it is now completely superseded by science.' (Dawkins 2006, p. 347). Darwinism takes pride of place in this argument—Dawkins refers to 'Darwin's destruction of the argument from design' (Dawkins 2006, p. 79)—but it is the success of science more generally that is claimed to make God unnecessary.

Christopher Hitchens appeals to Ockham's razor to articulate why he thinks belief in God is unnecessary in light of modern science (Hitchens 2007, pp. 70–71) and this point is picked up by Andrew Johnson in his apology for the New Atheism (Johnson 2013). Johnson responds to several criticisms of the New Atheism, but of relevance here is his response to the charge that their atheism is 'epistemically just as unwarranted as the fundamentalist theism they criticize' (Johnson 2013, p. 7). He points to their reliance on the presumption of atheism and Ockham's razor, maintaining that understanding the role of the latter in their thought is 'essential for seeing that their atheism is not a matter of blind faith or epistemic overreach' (Johnson 2013, p. 11). He writes:

> The point that Ockham's Razor shaves off the God hypothesis should deflect the charge that the New Atheism is faith-based, since it takes no faith to believe in the simpler of two competing hypotheses (naturalism) when the more complex hypothesis (supernaturalism) isn't redeemed by possession of other explanatory virtues to a greater degree.[13] (Johnson 2013, pp. 13–14)

Johnson is no doubt correct to emphasize the importance of Ockham's razor in the thinking of the New Atheists, but that does nothing in itself to rebut the charge levelled against them. In the passage quoted, Johnson pits naturalism and supernaturalism as competing hypotheses, but what does the hypothesis of naturalism explain? What the New Atheists actually do is to appeal to *scientific* hypotheses, which certainly do explain a lot, but they cannot be assumed to be part of naturalism in the metaphysical sense that Johnson clearly has in mind without begging the question. Are scientific hypotheses in competition with supernaturalism? There is no logical conflict so they are not competing in that sense. The most plausible way to make sense of the competition Johnson has in mind is in terms of explaining away. The New Atheists then apply Ockham's razor in a way similar to the SEAGA argument in Sect. 3 so that there is no need for theistic explanations in addition to scientific explanations and so science explains away evidence for theism.

However, can Ockham's razor be legitimately applied in this way? As discussed in Sect. 3, it cannot simply be assumed to apply. Hence, if such a claim is to be made, detailed argument is needed to demonstrate that the relevant conditions are satisfied, but such arguments are completely lacking in the New Atheism. The New Atheists tend to assume that theism is made redundant simply by virtue of science's explanatory power. This presupposes the application of Ockham's razor, but they fail to address the kinds of issues relevant to this claim that were identified in Sect. 3.

Also, are the New Atheists right to claim that theism 'isn't redeemed by possession of other explanatory virtues to a greater degree'? Johnson claims that the New Atheists have put forward refutations of the most important traditional arguments and asks 'where do they go wrong?' (Johnson 2013, p. 15). The problem is that the New Atheists' refutations are very weak. Consider Dawkins' response to the cosmological argument where he claims that rather than invoking God it would be 'more parsimonious to conjure up a "big bang singularity", or some other physical concept as yet unknown' (Dawkins 2006, p. 78). Here Dawkins seems oblivious to the fact that it is precisely the big bang singularity that raises at least a *prima facie* problem for atheism since it marks the beginning of the universe and provides impetus for another version of the cosmological argument, the Kalām argument. Irrespective of the merits of such arguments, in general it is clear that Dawkins fails to do justice to the best atheistic objections to theistic arguments, never mind to the best defences of the arguments themselves.

This does not mean that a plausible argument from the success of science conjoined with Ockham's razor in defence of naturalism is impossible; just that the

[13] Like the New Atheists, Johnson views faith as 'ungrounded belief', which is highly contestable, but will not be considered further here.

New Atheists have not made it. While Johnson has clarified their reasoning, if the argument in Sect. 3 of this paper is correct, he too has underestimated the challenges that such an argument faces.

5 Conclusion

This paper has provided an evaluation of arguments against theism based on the success of science. The general idea is that as science progresses, explaining more and more natural phenomena, God becomes increasingly redundant. While this type of argument is very common at a popular level, it is rarely spelled out in detail. In this paper, the argument has been formulated using a probabilistic account of the conditions for application of Ockham's razor and referred to as SEAGA. The key point is that it is much more difficult to demonstrate that the conditions for application of Ockham's razor are satisfied in a given science–religion context, never mind more generally, than is often assumed.

Various strategies are open to the theist in response to SEAGA, but some of these seem rather weak and perhaps serve to highlight the appeal of SEAGA. The best strategy for the theist is to argue that science may well depend on theism. Several standard theistic arguments suggest such a dependence which would call into question the application of Ockham's razor. This results in a significant problem for defenders of SEAGA because unless they can refute these theistic arguments and show that science does not depend on theism, it is unlikely that a persuasive case can be made for SEAGA. Furthermore, SEAGA loses its intuitive appeal since it might have been thought that appealing to the success of science and Ockham's razor would circumvent the need for detailed engagement with standard theistic arguments, but that turns out not to be the case.

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